CLAIMS

It is manifestly intended that this invention be only limited by the claims and equivalents thereof.

What is claimed is:

51. A deployment mechanism for expendable space tether applications comprising essentially a fixed single-layer tether winding cylinder (6), a multiple-layer tether winding central spool (8), an initial separation impulse mechanism (10) for passive tether deployment, and a tether deployment brake (12) of daisy-like shape; characterised in that

said mechanism accommodates a first portion of tether (7), many kilometres in length, wound up on said inner multi-layer spool (8), followed by a second portion of said tether (7), many hundred metres in length, wound up in a single layer on said outer cylinder (6). In order to allow the passage of the tether (7) both on ground, during the required tether winding and preparatory operations, and on-orbit, during the actual deployment by the unwinding of its two types of tether windings, a surface cut (9) of said outer cylinder (6) of sufficient width and along most of its length is provided. In this way once the continuous space tether is deployed on orbit, the unwinding tether will pass through said cylinder cut (9) and will continue to unwind from said multi-layer central spool (8) till the end of deployment;

- said initial separation impulse mechanism for passive tether deployment comprises a central sinusoidal spring (10), mounted inside the core of said fixed multi-layer tether spool (8) and capable of storing the required energy for initial separation of the tethered masses; said separation spring (10) is kept in a compressed state, during ground operations and ground and space transportation and before on-orbit separation and deployment, by some, usually three, pyro-bolts (3) mounted on the mechanism cover (1) and its interface plane with the external surface (2) of the carrier spacecraft; at separation time, on command coming from ground through the carrier spacecraft telemetry and telecommand on-board system, said pyro-bolts (3) are actuated, said central spring (10) is released and the whole deployment mechanism, with its cover (1), spring (10)

and full tether windings, will separate about the orbit local vertical direction from said carrier spacecraft (2); and

- said passive tether deployment brake (12) of daisy-like shape and flexible material, incorporated within said centrally fixed multi-layer spool tether winding (8) and fixed on the spool central core mounting, will deploy on-orbit during tether deployment operation at the planned length of the deployed tether or distance of the tethered end-masses; the deployment of this device increases by the planned magnitude or amount the tether deployment friction resistance force, so that the decreasing of the tether deployment rate from the deployer mechanism is gradually provided and applied until the end of the deployment operation.

2. The deployment mechanism claimed in claim 1, further comprising a tether mechanism interface plane (13), to be bolted onto said external surface (2) of the carrier spacecraft, an external protective cover (1) bolted by said pyro-bolts (3) to said interface plane (2) with the carrier spacecraft, mountings of the carrier-end tether attachment (16), electronic boxes (17), data and power interface connectors (5), and an outer tether winding V-shaped gripping or restraining device (18); characterised in that

- said tether mechanism interface plane (13) is bolted to an external surface (2) of said carrier spacecraft by substantially three simple bolts (19) and remains mounted onto the external surface of the carrier, with electronics and other components of the deployment device, after on-orbit initial separation of the deployer mechanism and deployment operations of the tether and the tethered end-masses; in that said external protective cover (1) bounded by said pyro-bolts (3) to the interface plane (13) with said carrier spacecraft is bolted as a single structure to said tether winding spool (8) structures with said spring separation device (10) incorporated; said cover (1) is also used as a protective shell, for the tether windings and all the other deployer mechanism components, mainly against potential micro-meteorite impacts and the material aging effects due to ultra-violet ray exposure or to exposure to other types of dangerous space radiation;

- said mountings of the attachment point of the tether end at the carrier spacecraft side, said electronics boxes (17) and said data and power interface connectors (5) of the tether application system, such as for the electro-dynamic tether propulsion application, and said V-shaped outer tether winding restraining or gripping device (18) are all mounted to be fixed and to remain on the mechanism interface plane, on the exterior of the carrier spacecraft until the end of the space tether application; the carrier spacecraft bound electronics components for the electro-dynamic tether application are represented by a hollow cathode (14), relays and current measurement and control electronics (15); and
- said V-shaped tether winding gripping device (18) is of elastic (beam) type and its mounting on the interface plane is in correspondence of said outer tether winding cylinder (6) end-border, so that the first few single layer tether winding spirals are gripped to the cylinder surface and the tether winding tension kept until on-orbit deployment separation action for which these tether winding spirals and cylinder are freed from said V-shaped restraining device (18).

3. A passive method for tether unwinding, based on the mechanism claimed in claim 1, characterised in that said tether unwinding comprises the following steps: an impulse applied for separation from said spacecraft (2) performed by said spring (10); tether unwinding from said single-layer cylindrical outer spool (6), involving a first tether length of many hundred metres with tether deployment resistance or friction force of value nearly equal to zero; further tether unwinding from said multi-layer spool (8), located inside said outer single-layer spool (6) of the remaining portion of the many kilometres long tether; and tether deployment braking action resulting from a constant friction force applied by means of said brake (12), through which said tether (7) is made to pass.